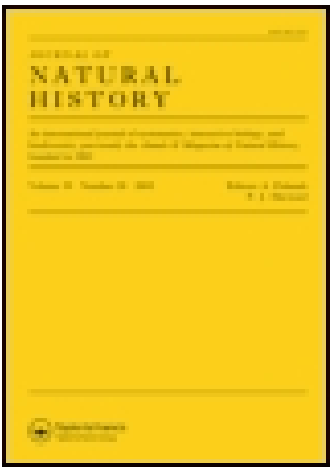
On: 14 February 2015, At: 13:11
Publisher: Taylor & Francis
Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Annals and Magazine of Natural History: Series 7

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/tnah13

IX.—The regeneration of limbs in the Mantidæ, and the constant occurrence of a tetramerous tarsus in limbs regenerated after self-mutilation among the Orthoptera pentamera

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Published online: 22 Sep 2009.

To cite this article: Edmond Bordage (1899) IX.—The regeneration of limbs in the Mantidæ, and the constant occurrence of a tetramerous tarsus in limbs regenerated after self-mutilation among the Orthoptera pentamera , Annals and Magazine of Natural History: Series 7, 4:20, 115-118, DOI: 10.1080/00222939908678171

To link to this article: http://dx.doi.org/10.1080/00222939908678171

beneath ochraceous; body beneath and legs carmine-red; apical half of anterior femora, apex of intermediate femora, and anterior and intermediate tibiæ pale greenish spotted with black.

Tegmina pale greenish, spotted with cretaceous, with two somewhat ill-defined transverse cretaceous fasciæ, and the following shining black spots, viz.: six on costal margin, two a little above centre of inner margin, and some sixteen on apical area. Wings pale cretaceous, their apices very slightly ochraceous and containing about thirteen small black spots.

Long. excl. tegm. 12 millim.; exp. tegm. 30 millim.

Hab. Transvaal, Lydenburg District (*coll. Dist.*).

There is a specimen of this species in the British Museum localized "N'Gami Country (*Lugard*)."

IX.—*The Regeneration of Limbs in the* Mantidæ, *and the constant Occurrence of a Tetramerous Tarsus in Limbs regenerated after Self-mutilation among the Orthoptera pentamera* *. By Edmond Bordage.

Numerous experiments which I have made upon the Phasmidæ, and which I have described in 'Comptes Rendus,' and before the Société de Biologie, have shown that among these insects a limb regenerated after self-mutilation constantly presents a tetramerous tarsus instead of a normal one with five joints. Messrs. Bateson and Brindley have made the same observation so far as the Blattidæ are concerned. It only therefore remains to be seen whether the same effect is produced in the third and last family of the Orthoptera pentamera, the Mantidæ.

I. I undertook the following researches in the island of Bourbon upon the two species of *Mantis* of the Mascarenes (*Mantis prasina* and *M. pustulata*) which are easy to rear in captivity.

In the case of the first pair of limbs (*predatory legs*) self-mutilation never takes place. The same does not hold good, however, in the two succeeding pairs. The leg becomes detached from the body at the groove which marks the trochantero-femoral articulation. Separation takes place with the utmost facility. The process of regeneration in the larvæ goes on with marvellous rapidity, more quickly even than

* Translated from 'Comptes Rendus,' cxxviii. (1899) pp. 1593–1596, by Wilfred Mark Webb, F.L.S.

appears in the case of the Blattidæ, but nevertheless by no means so fast as I have found it to take place in the Phasmidæ.

The tarsus of a regenerated limb is always tetramerous, and the relative size of its joints is as constant as in the normal pentamerous structure. The same thing holds good also in the case of the Phasmidæ and Blattidæ.

II. It is important to note, in the three families of the Orthoptera pentamera, the way in which the replacing limb grows. Instead of developing freely and in a rectilinear manner at the surface formed by the mutilation, the limb must continue to grow, until the next moult, under the skin, which soon covers the wound. The skin is very thin and not at all chitinized, consequently retaining a certain elasticity and transparency even in the Phasmidæ. The limb in process of regeneration barely makes a projection under the skin or is so little apparent that in most cases it needs careful examination to determine its presence.

The young limb in order to develop under these conditions is obliged to coil upon itself and assume a spiral form *. It is then not seen until the next moult sets it at liberty. When it appears it is in the form of a little blackish appendage, hardly a millimetre or two in length, a smallish limb which immediately unrolls, becoming turgescent and rectilinear. From black the limb becomes rapidly of the customary yellowish green, except in the Blattidæ and certain Phasmidæ, which are of a brown colour.

These changes take place under observation with a rapidity which is really marvellous, and comparable to that which we see in the development or, rather, extension of the wings, especially in the Lepidoptera, when the perfect insect has just left the chrysalis.

In a communication read before the Académie des Sciences (at the meeting of June 28th, 1897), I pointed out in the Phasmidæ a sensible difference between the rate of growth of a normal limb and one in process of regeneration, which was to the advantage of the latter. This difference is even more noticeable in the Blattidæ, and greater still in the Mantidæ. In the last-mentioned Orthoptera, when self-mutilation has

* Limbs in process of regeneration develop in the same way among the Orthoptera saltatoria. Such a process is also constant in regeneration that follows artificial removal of the tarsus and the distal end of the tibia, although at first sight certain differences may appear to exist. The rule ought probably to be a general one in the Arthropoda, in which regeneration of lost appendages (including antennæ) takes place. I am surprised that Messrs. Bateson and Brindley have not recorded this remarkable point in their fine work on the Blattidæ.

taken place in very young larvæ, I have seen the reproduced limb attain in the interval between two moults to the size of the corresponding limb which had persisted. Such perfection, which ought also to be reached in certain cases among the Blattidæ, is never so great in the Phasmidæ. In fact, the smallest difference that I have been able to note in members of this family between corresponding limbs, one normal and one replaced, has been 4 mm. at least, and consequently noticeable enough. I must add an important point: whilst in Mantidæ and Blattidæ the regenerated limb becomes rectilinear directly after the moult which liberates it, and in the majority of instances is ready to do work immediately, this is never the case in Phasmidæ, for the newly formed leg unrolls itself bit by bit, and does not become definitely rectilinear until after the second moult which follows the automatic mutilation.

III. I have been able to determine in the Mantidæ that apart from the region of the trochantero-femoral articulation, the regenerative power is still apparent in the tarsus and in the extreme terminal part of the tibia after artificial amputation. The regenerated tarsus is four-jointed. The position of the regenerative surfaces is the same in all the three families in the Orthoptera pentamera*.

In order that there may be regeneration when artificial severance of the predatory legs is resorted to in the Mantidæ the tarsi alone must be injured. Although impeded by this mutilation, the Mantids can nevertheless seize their prey. If the least part of the tibia is wounded, the Orthopteron is unable to catch insects, and quickly dies of hunger if not from loss of blood.

Up to the present tetramerous regeneration of the tarsus has been observed in eighteen species of Orthoptera pentamera spread over the three families. The names of the insects are appended :—

A. Phasmidæ (Ed. Bordage's experiments).—*Monandroptera inuncans, Raphiderus scabrosus, Eurycantha horrida, Phyllium siccifolium* †.

* This is not surprising seeing that the same causes which bring about the mutilations (among the number of which it should be pointed out in the first place are the great strains brought to bear during moulting upon such fragile structures as the tarsus). We shall prove the same point in the case of the Orthoptera saltatoria. Among the Phasmidæ one must include the tarsal mutilations caused by the egg-shell (see 'Comptes Rendus Soc. Biologie,' Meeting of July 30, 1898, E. Bordage, "Sur les localisations des surfaces de régénération chez les Phasmides").

† Bull. Soc. entom. de France, 1898, no. 16, pp. 306 & 307.

B. MANTIDÆ (Ed. Bordage).—*Mantis prasina, M. pustulata.*

C. BLATTIDÆ (Brisout, Bateson, and Brindley).—*Periplaneta americana, P. australasiæ, P. orientalis, Blabera atropos, Nyctibora latipennis, N. sericea, Epilampra cinerea, Homalosilpha ustilata, Leucophœa surinamensis, Monachoda grossa, Panesthia javanica, Phyllodroma germanica.*

It seems to follow from these observations that as a rule tetramerous regeneration of the tarsus in Orthoptera pentamera after self-mutilation has its seat in the trochantero-femoral groove.

X. — *On the Rutelid Beetles of the Transvaal; an Enumeration of a Collection made by Mr. W. L. Distant.* By GILBERT J. ARROW, F.E.S.

THE insects enumerated in this paper form part of the large collection made by Mr. W. L. Distant in successive visits to the Transvaal during the years 1890–1 and 1893–6. Of the new species described here types have been kindly presented by him to the British Museum.

Anomala transvalensis, Arrow, Trans. Ent. Soc. Lond. 1899, p. 258.

Anomala Distanti, Arrow, *ibid.*

These two species are remarkable for sexual differentiation in the structure of the claws, the female having divided claws upon each of the anterior pairs of legs and the male upon the first pair only.

Anomala ustulata, sp. n.

Elongato-ovata, pallide testacea, capite (clypeo paulo dilutiore), thoracis vittis tribus, scutelli margine (superficie tota rarius) suturaque nigris, pygidio aliquando plus minusve fusco, tarsis ferrugineis; capite parvo, rugoso, clypei margine valde reflexo; prothorace brevi, lateribus regulariter arcuatis, angulis posticis obtuse rotundatis, subtilissime punctato, linea media obsolete impresso, vitta longitudinali media et duabus obliquis lateralibus ad basis medium omnibus directis, nigris; scutello crebre punctato; elytris elongatis, post mediam ampliatis, profunde punctato-striatis, striis nonnunquam fuscescentibus; pygidio subtiliter punctato-rugoso; tibiis anticis acute bidentatis, tarsorum anticorum et intermediorum utroque sexu unguibus externis apice fissis.

Long. 16–18 mm.

Hab. Pretoria.